

Two new species of *Photonectes* (Teleostei: Stomiidae) from the Indo-Pacific, and a re-examination of *P. achirus*

FLYNN, A. J.^{1,2,3} AND KLEPADLO, C.⁴

¹ The University of Queensland, School of Biomedical Sciences/Queensland Brain Institute, St. Lucia 4071, Queensland, Australia (adrian.flynn@uqconnect.edu.au)

² CSIRO Marine and Atmospheric Research, PO Box 1538, Hobart 7001, Tasmania, Australia

³ Museum Victoria, Ichthyology, PO Box 666, Victoria 3001, Australia

⁴ Marine Vertebrate Collection, Scripps Institution of Oceanography, University of California at San Diego, 9500 Gilman Drive, La Jolla, California, USA 92093-0208. (cklepadlo@ucsd.edu)

Abstract

Flynn, A. J. and Klepadlo, C. 2012. Two new species of *Photonectes* (Teleostei: Stomiidae) from the Indo-Pacific, and a re-examination of *P. achirus*. *Memoirs of Museum Victoria* 69: 259–267.

Two new species of the mesopelagic fish genus *Photonectes* (family Stomiidae) from the Indo-Pacific are described. Both are referred to the subgenus *Photonectes* because they lack pectoral fins, have no fleshy tissue on their dorsal- and anal-fin rays, have a pelvic-fin insertion closer to the caudal-fin base than the snout, and have IP photophores located on the isthmus at a position midway along the mandible, posterior to the mandibular symphysis. *Photonectes waitti* sp. nov., known from the tropical western and central Pacific Ocean, northwestern Coral Sea and north Indian Ocean, is most similar to *P. coffea*, differing from it by the number of PV photophores (24–25 vs. 29–31), gill filaments reduced (vs. greatly elongate), jaw teeth long and short canines (vs. short canines only), and barbel length less than (vs. equal to or greater than) head length. *Photonectes paxtoni* sp. nov., known from the tropical western Pacific Ocean, off Papua New Guinea, has a short barbel, less than head length, ending in a very large bulb without any terminal filaments or appendages, and different photophore numbers compared to other members of the subgenus: VAV 15–16 (vs. 10–15), AC 13 (vs. 9–12), and IV 29 (vs. 30–46). *Photonectes achirus* is re-examined with respect to previously unreported dark pigment on the head.

Keywords

Photonectes, Stomiidae, new species, Indo-Pacific

Introduction

The Stomiidae is a very speciose family of midwater fishes, currently comprising approximately 280 species in 27 genera (Nelson, 2006; Eschmeyer, 2011; Froese and Pauly, 2011). The genus *Photonectes* has 25 nominal species, 16 of which are regarded as valid species (Eschmeyer, 2011; Froese and Pauly, 2011).

In 2009, 21 specimens of an apparently undescribed species of *Photonectes* were collected from the equatorial western Pacific Ocean, in the vicinity of Howland and Baker islands. In 2010, an additional specimen was collected in the Coral Sea off Cairns, Australia. The examination of material from museum collections revealed two more specimens, extending the range of the species into Hawaiian waters and the Gulf of Aden. The search for additional material resulted in the discovery of another undescribed species collected in 1969 by the Australian Museum off Papua New Guinea. Both species are members of the subgenus *Photonectes* based on the lack of pectoral fins, their dorsal and anal fins not enveloped with fleshy tissue, their pelvic-fin insertion located closer to caudal-fin base than to the snout tip, and their IP photophores

located on the isthmus at a position midway along the mandible, posterior to the mandibular symphysis (Regan and Trewavas, 1930; Morrow and Gibbs, 1964; Klepadlo, 2011). Descriptions of these two species are provided herein.

Besides photophores and barbels, other dermal features that aid in identification of species of *Photonectes* include the presence or absence of white luminous tissue patches on the head and body and the presence or absence of ventro-lateral blue luminous tissue markings on the body, along the isthmus and inside the mouth.

Specimens of *P. achirus* were collected along with specimens of the former undescribed species in the equatorial western Pacific Ocean in the vicinity of Howland and Baker islands. While examining museum specimens of *P. achirus*, patches of dark pigment were observed on the head that were previously unreported (e.g., in Regan and Trewavas, 1930; Beebe and Crane, 1939; Morrow and Gibbs, 1964; Klepadlo, 2011). The patches of dark pigment were only observed on faded museum specimens, usually rusty-brown in colour, that had been preserved for a long period of time. The dark pigment was not detectable in freshly-caught specimens that were usually

black or black-brown in color. Faded museum specimens of other *Photonektes* species were examined, but these markings were found only on specimens of *P. achirus*. A re-examination of *P. achirus* is provided on the basis of this new finding.

Methods

Values for selected morphometric and meristic features in the new species are given in Table 1. Measurements were made with vernier calipers to the nearest 0.1 mm and include: standard length (SL), head length (HL), barbel length, and lengths from snout to pelvic fin (Sn-V), from pelvic fin to vent (V-vent), and from vent to base of caudal fin (vent-C). Percent of SL (% SL) was calculated for *P. waitti* and *P. paxtoni* and % SL values for *P. achirus* were derived from Morrow and Gibbs (1964) and Froese and Pauly (2011). Descriptions of teeth are given and these were separated as premaxillary, maxillary, mandibular, vomerine, palatine and basibranchial; maxillary teeth are further divided into "erect" (anterior canines) and "oblique" (posterior series of very small inclined teeth). Photophore terminology (Figure 1) follows Morrow and Gibbs (1964), Harold (2003), and Klepadlo (2011). In addition to diagnostic counts of the primary photophores, descriptions are given of small secondary photophores that occur as clusters or form lateral bars in the genus *Photonektes*. Further, descriptions are made of two opercular (OP) photophores: the pre-opercular photophore (PRO) at the posteriodorsal margin of the operculum and the subopercular photophore (SO) located in a cup-like depression ventral to the PRO (notation follows Weitzman, 1974: Table 1).

Gill-filament length (Klepadlo, 2011: Fig. 2) on first branchial arch is defined as "1st reduced" (less than one-half arch depth), "normal" (longer than arch depth but not extending beyond opercular opening) or "very long" (much greater than depth or arch and extending beyond opercular opening).

Most specimens were collected with a neuston net. Other collection methods included Isaacs-Kidd midwater trawl (IKMT), IKMT modified to collect plankton (IKPT) (Williamson and McGowan, 2009), rectangular midwater trawl (RMT) and a bottom trawl. Collection depths are given in meters (m), fathoms (fm) or meters-wire-out (mwo). Time of collection listed for *P. waitti* sp. nov. is given in UTC/GMT. Notes on the color (under visible light) of fresh specimens of *P. waitti* are based on observations made by the first author in the field.

Material examined is in the collections of the Australian Museum (AMS), Museum of Victoria (NMV), Scripps Institution of Oceanography (SIO) and Smithsonian Institution (USNM).

Photonektes waitti new species

Figures 2a,b, 5; Table 1

Holotype: NMV A 30913-001 (71.4 mm SL), 0°34.836'—35.329'N, 176°56.432'—49.956'W, neuston net, 0—0.5 m depth, R/V Seward Johnson, Catalyst II expedition, 06 March 2009, 14:04—15:05.

Paratypes: AMS 1.49494-010 (48.7 mm SL), 16°34.25'S, 147°08.01'E, 11 December 2010, 19:43—20:43, RMT8 trawl, 330 m depth; NMV A 30908-001/-002 (2: 22.5—32.6 mm SL), 0°21.243'—21.257'N, 176°50.117'—49.575'W, 23 February 2009, 12:17—13:17, neuston, 0—0.5 m depth; NMV A 30915-001 (1: 32.1 mm SL) and SIO

11-301/-302 (2: both 48.5 mm SL), 0°27.568'—27.658'N, 176°51.848'—50.574'W, 28 February 2009, 12:32—13:32, neuston, 0—0.5 m depth; NMV A 30906-001/-002/-003/-004/-005 (5: 31.6—51.0 mm SL), collected with holotype; NMV A 30908-001/-002 (2: 22.5—32.6 mm SL), 0°21.243'—21.257'N, 176°50.117'—49.575'W, 23 February 2009, 12:17—13:17, neuston, 0—0.5 m depth; NMV A 30907-001/-002/-003/-004 (4: 25.2—30.7 mm SL), 0°54.289'N, 177°09.476'W, 02 May 2009, neuston net, 0—0.5 m depth; SIO 11-300 (37.6 mm SL), 0°13.518'—13.212'N, 176°46.428'—45.634'W, 19 February 2009, 07:43—08:43, neuston, 0—0.5 m depth; SIO 11-303 (2: 25.4—41.5 mm SL), 0°53.000'—50.586'N, 176°57.332'—56.657'W, 20 March 2009, 12:59—13:57, neuston net, 0—0.5 m depth; USNM 402774 (32.3 mm SL), 01°19.045'—18.335'N, 176°47.913'—47.673'W, 19 April 2009, RMT trawl M205, 1200 m depth; USNM 300149 (23.4 mm SL), 12°40'N, 51°13'E, 1 m plankton net, captured at surface, R/V *Anton Bruun* Cr. 5, sta. 287A, IIOE Expedition, 3 February 1964; USNM 300199 (26 mm SL), 21°20'—30'N, 158°20'—30'W, 26 September 1973, 3 m IKMT, 0—110 m depth, T. Clarke 73-9-33; USNM 300201 (24.8 mm SL), 21°20'—30'N, 158°20'—30'W, 30 August 1973, 03:18—05:15, 3 m IKMT 0—350 m depth, T. Clarke 73-8-31.

Diagnosis: Differs from other species in the subgenus *Photonektes* in the following combination of characters: dorsal-fin rays 11—14, anal-fin rays 12—16; IV photophores 38—39, PV photophores 24—25; absence of blue luminous tissue; length of gill filaments on first branchial arch reduced, less than depth of gill arch; and barbel with two large bulbs in series. Few species of *Photonektes* have more than one large bulb or luminous area on the barbel (secondary photophores excluded). Above the main bulb in *P. mirabilis* are small bulbs on the stem and a tiny terminal bulb. *P. phyllopogon* has a single bulb and a terminal luminous appendage (Morrow and Gibbs, 1964). *P. barnetti* has a large pale area along the stem below the bulb (luminescent colour uncertain) (Klepadlo, 2011). *P. coffea* has two bulbs in series without any terminal bulb (Klepadlo, 2011). For *P. waitti* there are two large bulbs in series and a tiny bulb at the end of the filament. *Photonektes waitti* differs from *P. mirabilis* and *P. phyllopogon* in having 11—14 dorsal-fin rays (vs. 16—17 and 20—23, respectively), 12—16 anal-fin rays (vs. 19—20 and 22—25, respectively), and 38—39 IV photophores (vs. 33—34 and 30—31, respectively). It differs from *P. coffea* in having gill filaments on first gill arch reduced (vs. very long, extending beyond gill opening), and PV photophores 24—25 (vs. 29—31). It differs from *P. achirus*, *P. caeruleus*, and *P. mirabilis* in lacking blue luminous tissue.

Description: Body elongate, 20.9—71.4 mm SL; depth about eight times into length. HL 3.2—8.7 mm (11.0—18.1% SL, mean 15.3%); Sn-V 13.3—47.9 mm (58.5—67.4% SL, mean 62.1%); V-vent 3.4—10.5 mm (13.9—21.4% SL, mean 18.2%); vent-C 4.3—13.0 mm (15.6—23.4% SL, mean 19.9%) (see Table 1). Eye 0.8—1.9 mm (17.2—29.3% HL, mean 23.5%). Opercle concave dorsally and lobate posteriorly. Gill filaments on first branchial arch reduced, length less than arch depth; tips of filaments dark. Color of body in life dark brown to black. On fresh specimens or undamaged preserved specimens, narrow black lateral bands in line with PV, VAV and AC photophores. On freshly caught specimens, these lateral bands could be seen to harbor minute secondary photophores and luminous patches (described further below).

Dorsal-fin rays 12 (11–14, rarely 15–16); anal-fin rays 14 (12–16, rarely 17–19); pelvic-fin rays 7 (rarely 6); pectoral fins absent. Dorsal and anal fins not covered with black fleshy skin. Pelvic fins inserted closer to caudal fin than to snout (33.1–42.4% SL vs. 58.6–67.4% SL); longest ray extending at least to anus (tips broken). Caudal fin forked and elongate; ventral lobe longer than dorsal lobe. All fin-rays covered with melanophores extending halfway along the length; membranes clear.

Photophores: IV 38–39, rarely 35–37 (IP 12, rarely 11 or 13; PV 24–25, rarely 22, 23 or 26); VAV 13–14, rarely 12 or 15; AC 11–12, rarely 13; OA 38–39, rarely 35–37 (OV 24–26, rarely 23; VAL 12–13, rarely 14–15), last 1 to 2 photophores over anal-fin base; BR-7, rarely 6. IP series beginning about halfway along isthmus length, approximately opposite BR-7; space between IP-8 and IP-9 about twice space between IP-1 and IP-2 making series 8 + 4. Anterior end of AC series raised, approximately even with last VAL photophore, tapering downward over anal fin base and ending along ventro-lateral caudal peduncle. Secondary photophores on head and body, mainly concentrated in vertical lines from dorsum to each PV, VAV and AC photophore; also between IV and OA series and along ventrum in rather horizontal lines; no secondary photophores on any fin-ray. Postorbital organ ovoid, 0.7–0.9 mm (12.3–18.8% HL, mean = 14.6%; skin flap over posterior end in NMV A.30907-003. One ovoid PRO photophore; one smaller circular SO photophore. SO photophore directed ventrally and placed in a cup-like structure. PRO and SO photophores of fresh specimens reddish pink under visible light. Blue luminous tissue and dark markings absent.

Teeth caniniform, long and short; premaxillary teeth longest, needle-like. Premaxillary teeth 5–8; 4–8 maxillary teeth erect and 4–10 oblique; mandibular teeth 11–25; vomerine teeth in 2 to 3 pairs, lateral teeth longest; palatine teeth in 2 pairs, about equal length; basibranchial teeth in 2 to 4 pairs (anterior and posterior pairs separated by gap, 1 to 2 pairs followed by 1 to 2 pairs; posterior tooth in each group longest).

Barbel shorter than head, 2.3–5.5 mm (59.0–85.4% HL, mean 74.0%), with two main bulbs and a fine terminal filament. One specimen (SIO 11-304) with very tiny bulb at distal end of terminal filament. Stem pigmented, no secondary photophores; first segment (~45% of barbel length) tapering into first bulb with pigment cup-like around bulb base. First bulb ovoid (~18% of barbel length), width about three times stem width, tapering into short segment of stem (~9% of barbel length) followed by second bulb. Section of stem between bulbs with melanophores increasing in concentration distally. Second bulb elongate (~18% of barbel length), narrow, about twice stem width, and with melanophore-line from stem extending length of bulb onto short terminal filament (~9% of barbel length). In freshly-caught specimens bulbs lavender to pink under white light.

Distribution: Known from tropical western and central Pacific Ocean, northwestern Coral Sea and Indian Ocean (Gulf of Aden) at depths of 0–1200 m.

Etymology: Named in recognition of Theodore (Ted) Waitt, the founder of the Waitt Family Foundation and the Waitt Institute. The Waitt Institute sponsored and directed the expedition of the R/V *Seward Johnson* to the equatorial western Pacific Ocean (Catalyst II expedition) during which this species was collected.

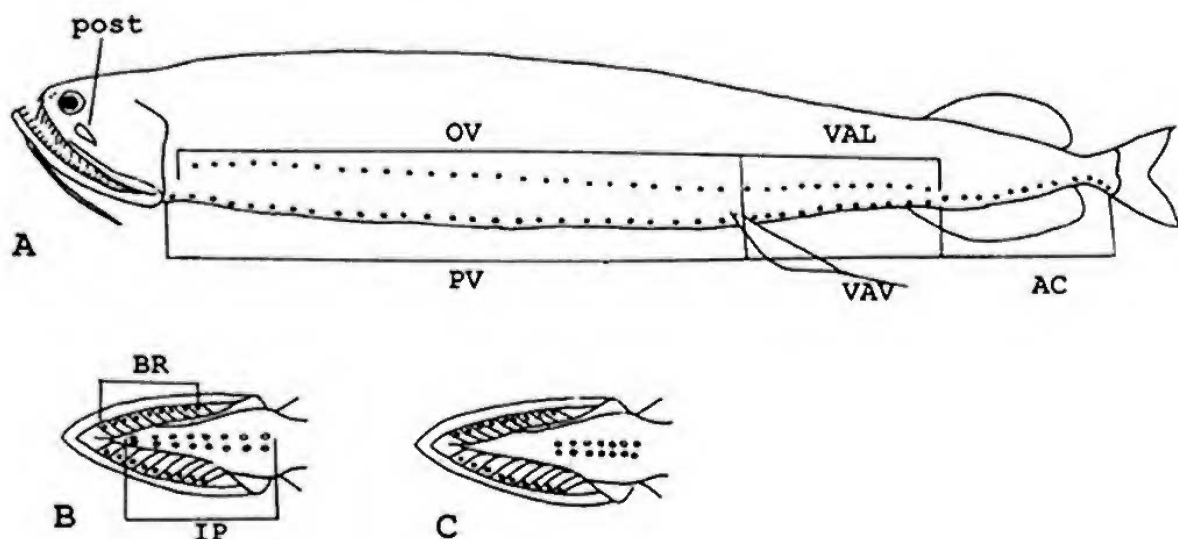


Figure 1. (A) Photophore notation: post – postorbital organ; VAV – ventrally, from pelvic fin base to anal fin origin; AC – from anal fin origin to caudal fin base; OV – laterally, from pectoral fin origin to pelvic fin origin; VAL – laterally, from pelvic fin origin to anal fin origin or slightly beyond; (B) and (C) IP – along isthmus to pectoral fin base commencing at mandibular symphysis or posteriorly halfway along isthmus length, respectively.



Figure 2. *Photonectes waitti* new species **a)** NMV A.30906-005, 51.0 mm, paratype; **b)** lateral view of head and barbel, NMV A.30913-001, 71.4 mm, holotype. Photograph by NMV.



Figure 3. *Photonectes paxtoni* new species, holotype, AMS I.1972043, 23.4 mm SL. Photograph by NMW.



Figure 4. *Photonectes achirus*, AMS I.19739-018, 32.3 mm, lateral view of head of showing dark marking at upper operculum (Photograph by C. Klepadlo).

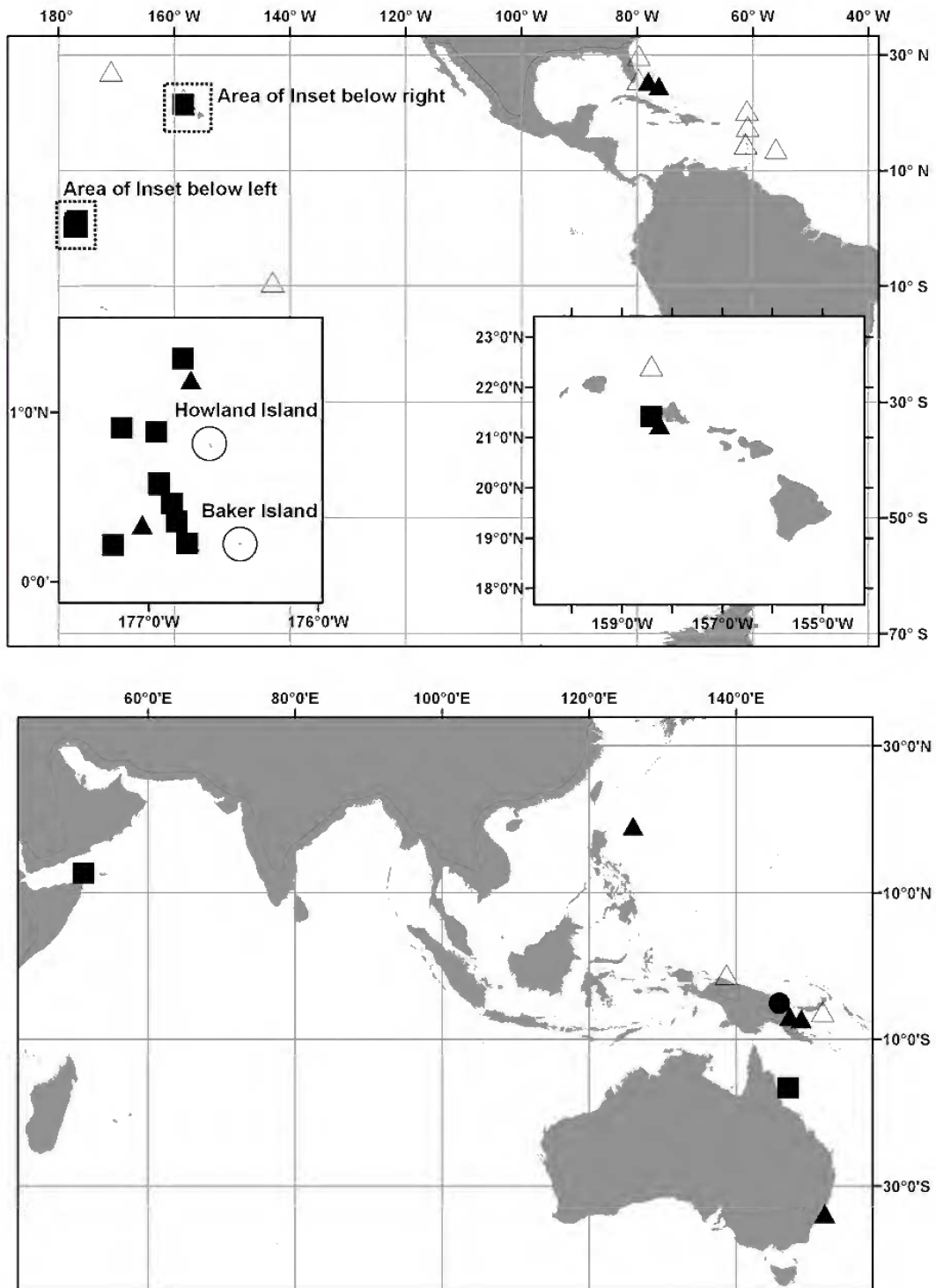


Figure 5. Distribution of *Photoneustes waititi* (black square), *P. paxtoni* (black circle), *P. achirus* (black triangle; white triangle = literature records). Symbols may represent more than one record

Table 1. Selected meristics and morphometrics of *Photonectes waitti*, *P. paxtoni*, and *P. achirus*. Values for holotypes followed by range for paratypes in parentheses where they vary from the holotype. Values for *P. achirus* from Morrow and Gibbs (1964) and Froese and Pauly (2011).

Character	<i>Photonectes waitti</i> (n=24)	<i>Photonectes paxtoni</i> (n=2)	<i>Photonectes achirus</i>
Standard Length (mm)	71.4 (20.9–74.0)	23.4 (22.4)	20.0–87.0
Fin Rays:			
Dorsal	12 (11–16)	16 (18)	14–16
Anal	14 (11–19)	18 (18)	14–19
Pelvic	7 (6–7)	7	7
Photophores:			
IP	12 (11–13)	8	8–11
PV	23 (22–26)	21	22–28
VAV	14 (12–15)	16 (15)	11–13
AC	11 (10–13)	13	10–11
OV	26 (21–26)	20	19–22
VAL	13 (12–15)	14	11–12
BR	7 (6–8)	8	6–8
%SL:			
Head	12.9 (12.1–18.9)	17.1 (15.6)	15.4–18.7
Sn-V	66.9 (58.5–67.4)	61.1 (61.6)	58.2–73.2
V-vent	14.7 (14.9–21.3)	15.4 (15.2)	8.7–21.1
Vent-C	18.2 (15.6–23.4)	23.5 (23.2)	15.6–22.8

Remarks: *Photonectes waitti* is a widespread tropical open-ocean species. Twenty-one specimens were collected in 2009 from the equatorial western Pacific Ocean. One specimen was collected in 2010 from Australian waters in the Coral Sea. While examining older (40+ years) museum specimens labeled *Photonectes* sp., three additional specimens were found that extended the distribution of *P. waitti* into the Central Pacific, in the vicinity of Hawaii, and the northwestern Indian Ocean (Gulf of Aden).

Photonectes paxtoni new species

Figures 3, 5; Table 1

Holotype: AMS I.1970-243 (23.4 mm SL), 05°05'S, 145°56'E, off Madang, Papua New Guinea, 27 October 1969, 2 m IKMWT, 135 m depth.

Paratype: AMS I.19727-023 (22.4 mm SL), 05°05'S, 145°54'E, off Madang, Papua New Guinea, 27 October 1969, 2 m IKMWT, 130 m depth.

Diagnosis: *Photonectes paxtoni* differs from other members of the subgenus *Photonectes* in the following combination of characters: barbel short, with a very enlarged ovoid terminal bulb lacking terminal appendages; absence of blue luminous tissue; length of gill filaments on first branchial arch reduced, less than arch depth; and VAV photophores 15–16 (vs. 10–15), AC photophores 13 (vs. 9–12) and IV photophores 29 (vs. 30–46). The bulb is remarkably large and plain (without filaments). The enlarged bulb is similar to *P. ovibarba* (synonym of *P. braueri*). However, *P. paxtoni* has no pectoral fins (vs. present, with 2 rays each), IV photophores 29 (vs. 32–33), AC photophores 13 (vs. 10–12), and the bulb lacks any terminal appendage (vs. bearing a small ovoid appendage). Another species with a large

bulb, *P. fimbria* (synonym of *P. parvimanus*), can also be eliminated based on the following: IV photophores 43–49 (vs. *P. paxtoni* with 29), IP photophores insert near mandibular symphysis or no gap (vs. insert halfway along the isthmus, or with gap), thick skin over dorsal- and anal-fin rays (vs. thick skin absent), and bulb with terminal flap increasing with growth (vs. no flap or terminal appendage; growth change unknown).

Description: Body elongate, 22.4–23.4 mm SL; depth about seven times into length. HL 3.5–4.0 mm (15.6–17.1% SL); Sn-V 13.8–14.3 mm (61.1–61.6% SL); V-vent 3.4–3.6 mm (15.2–15.4% SL); vent-C 5.2–5.5 mm (23.2–23.5% SL) (see Table 1). Eye 1.0–1.1 mm (25.0–27.5% HL). Opercle lobate, slightly concave dorsally. Gill filaments on first branchial arch reduced, length less than arch depth; tips of gill filaments unpigmented. Color of body rusty-brown in preservative, assumed black in life.

Dorsal-fin rays 16–18; anal-fin rays 18; pelvic-fin rays 7; pectoral fins absent. Dorsal and anal fins not covered with black fleshy skin; fin-rays covered with minute white luminous spots; membranes clear. Pelvic fins inserted closer to caudal fin than to snout tip (38.4–38.9% SL vs. 61.1–61.6% SL); longest ray extending to anal-fin origin. Caudal-fin rays broken; fin assumed forked.

Photophores: IV 29 (IP 8; PV 21); VAV 15–16 (last 2 to 3 over anal-fin base); AC 13; OA 34 (OV 20; VAL 14, last two photophores over anal-fin base); BR 8. IP series beginning posteriorly about halfway along isthmus length, opposite BR-8; photophores evenly spaced. Anterior end of AC series beginning on same level as last VAV. Secondary photophores scattered over head and body, in clusters along dorsum, tapering ventrally to between each OA photophore, continuing ventrally between each IV photophore, and in clusters along ventral surface; none

on any fin rays. Postorbital organ ovoid, elongate, about equal to eye diameter. One PRO and one SO photophore on operculum, and one postorbital photophore. Specimen AMS I.1927-023 with a pair of white luminous spots on snout between nostrils. Blue luminous tissue and dark markings absent.

Teeth caniniform, long and short; premaxillary teeth longest, needle-like. Premaxillary teeth 4; 5–7 maxillary teeth erect and 8 oblique; mandibular teeth 12–15; vomerine teeth one pair; palatine teeth absent; basibranchial teeth 4 (one pair anteriorly and two single teeth midlength). Vomerine teeth long, length equal to longest premaxillary tooth.

Barbel short, 1.5–1.8 mm (42.9–45.0% HL), with very large ovoid bulb. Stem short, ~1.0 mm (~25% HL), pigment tapering anteriorly onto base of bulb in a small V-shape; no secondary photophores on stem. Bulb large and simple, with no appendages or terminal filaments; width ~1.0 mm. Color of bulb in life unknown.

Distribution: Known only from type locality off Madang, Papua New Guinea; depth 130–135 m.

Etymology: The name recognises Dr. John Paxton for his many contributions to the study of mesopelagic fishes and for his encouragement to the authors.

Remarks: *Photonectes paxtoni* is currently known from two specimens from shallow collections (depth 130–135 m). They were located among 46-year-old museum specimens labeled *Photonectes* sp.

Photonectes achirus Regan and Trewavas, 1930

Figures 4, 5; Table 1

Material examined: AMS I.19739-018 (32.3 mm SL), 07°09.0'S, 148°52.0'E (western Solomon Sea), 110 m depth, 7 November 1969; AMS I.19753-037 (2: 25.3–30.9 mm SL), 05°51.0'S, 147°20.0'E (Papua New Guinea, Vitiaz Straits), IKMT, 0–110 m depth, 4 November 1969; AMS I.24859-002 (78.0 mm SL), 33°43.0'–40.0'S, 152°03.0'–05.0'E (Australia, off Sydney, NSW), bottom trawl, 0–1135 m depth, 16 October 1984; NMV A 30906-006 (46.4 mm SL), 0°34.836'–35.329'N, 176°56.432'–49.956'W, neuston net, 0–0.5 m depth, 6 March 2009; NMV A 30917-001 (46.7 mm SL), 0°14.213'–14.354'N, 176°45.843'–45.641'W, neuston net, 0–0.5 m depth, 19 February 2009; SIO 11-305 (72.2 mm SL), 01°11.503'–10.113'N, 176°45.152'–46.050'W, RMT, 600 m depth, 26 April 2009; SIO 11-306 (83.5 mm SL), 0°20.264'–18.657'N, 177°02.297'–00.516'W, RMT, 600 m depth, 9 May 2009; SIO 70-333 (33.5 mm SL), 19°11.0'–04.8'N, 125°12.7'45.0'E, 10 ft IKMT, 0–2000 m depth, 13 September 1970; SIO 88-194 (21.4 mm SL), 24°40.5'N, 76.16'W (Exuma Sound), IKMT, 200 m depth, 14 July 1986; SIO 88-197 (23.0 mm SL), 25°28.0'N, 78°07.3'W (Tongue-of-the-Ocean), IKMT, 200 m depth, 8 January 1987; USNM 300205 (36.7 mm SL), 21°10'N, 158°10'W, IKMT, 0–775 m depth, 8 November 1974, 12:35–17:12, T. Clarke 74-11-4.

Diagnosis: *Photonectes achirus* differs from other species in the subgenus *Photonectes* in the following combination of characters: presence of blue luminous tissue in a band extending from pectoral region to pelvic fins, with short transverse streaks between OV photophores, and in patches on sides of isthmus, under lower jaw and above end of maxillary; length of gill filaments very long, extend beyond opercular

opening; and barbel shorter than head length, with small bulb ending in a terminal appendage with a tiny bulb at tip.

Re-Examination: Body elongate, largest recorded specimen 87.0 mm SL. Morphometric and meristic values for four specimens collected from waters around Howland and Baker islands were in agreement with Morrow and Gibbs (1964): body depth 11.8–16.7% SL; head 15.4–18.7% SL (mean 14.8%); Sn-V 58.2–73.0% SL (mean 65.6%); V-vent 8.7–21.1% SL (mean 14.4%); vent-C 15.6–22.8% SL (mean 20.1%). Eye 7.7–28.8% HL (mean 20.7%). Opercle slightly concave dorsally. Gill filament very long, feathery; extending slightly beyond gill cover; tips of filaments uncolored. Color of body black, fading to rusty brown in preservative.

Dorsal-fin rays 14–16; anal-fin rays 14–19; pelvic-fin rays 7; pectoral fins absent. Dorsal and anal fins not covered with black fleshy skin. Pelvic fins inserted closer to caudal fin than to snout tip; longest ray extending posteriorly to vent. Caudal fin forked; ventral lobe longer than dorsal lobe. All fin rays covered with melanophores along full length; membranes clear.

Photophores: IV 31-36 (IP 8–11 + PV 22–28); VAV 11–13; AC 10–11; OA 30–35 (OV 19–22; [rarely 23] + VAL 11–12 [rarely 9–10 or 13–15], last two photophores over anal-fin base); BR 6–8. IP series begins about halfway along isthmus length, approximately opposite posterior most BR; IP photophores noticeably smaller than body photophores. Anterior end of AC series raised, about one photophore diameter above last VAV, gently tapering to ventral profile. Secondary photophores very small, scattered over head and body; most densely clustered along dorsum; no secondary photophores on any fin-ray. Postorbital organ ovoid, with dark cap of melanophores along dorsal margin or with cluster of melanophores at anterior margin; length up to 30% HL.

Clusters of small white luminous spots on opercle. Blue luminous patch under OV-1 to OV-2; two patches along isthmus from symphysis to BR-1; pair of spots between eyes and small spots dorsal to occipito-vertebral articulation (“nape”); one pair anteriorly inside mouth; midventral stripe from below pectoral fins to pelvic fins, with short transverse streaks alternating with serial photophores.

Teeth caniniform, long and short; premaxillary teeth longest, needle-like. Premaxillary teeth 7–12; 6–8 maxillary teeth erect and 7–10 oblique; mandibular teeth 17–22; vomerine teeth 1 or 2 pairs; palatine teeth 1 pair; basibranchial teeth 4 pairs (anterior and posterior pairs separated by gap: 1 or 2 pairs followed by 2 or 3 pairs).

Barbel shorter than head length (70.0–80.0% HL). Stem covered with melanophores, terminating in a small bulb, slightly wider than stem width, with a long slender terminal appendage ending in a small bulb at tip.

Comment on Pigmentation: In older, faded museum specimens small to large dark semi-circular patches on snout and upper opercle (Fig. 4; see Discussion). The dark patches were observed on older faded specimens of *P. achirus* (AMS I.19739-018, SIO 70-333, SIO 88-194, SIO 88-197) on the snout between the nostrils and on the upper opercle (see Fig. 4). They are circular to slightly ovoid in shape, contain darker spots and are bordered

by heavy pigment. Examination of more recently collected (unfaded) specimens of *P. achirus* (SIO 11-305, SIO 11-306) did not reveal the colouration observed in older (faded) specimens. Several specimens did have clusters of secondary photophores at the upper opercular margin that are probably associated with the dark spots. However, other areas on the body with secondary photophores were not surrounded by any dark patches. One specimen of *P. achirus* (USNM 300205) had noticeable clusters of white luminous tissue on the nape and along the opercular margin with no dark patches surrounding the clusters; snout tissue was damaged. The skin on the head of *P. cf. gracilis* (USNM 300157) is in very good condition with both secondary photophores and a large cluster of white luminous tissue at the upper opercular margin; there is no indication of dark patches. Other faded *Photonectes* were examined for dark patches: *P. albipennis* (AMS I.221809-030, SIO 73-149), *P. braueri* (AMS I.20305-013), *P. caeruleus* (SIO 76-6), *P. margarita* (SIO 69-354), *P. mirabilis* (AMS I.19739-018), *P. parvimanus* (SIO 10-177), *P. paxtoni* (AMS I.19727-023, AMS I. 19702-043), *P. waititi* (USNM 300149, USNM 300201); none showed any trace. The significance of the tissue is unknown; it is not noticeable in fresh specimens nor is it reflective or photogenic. In reviews of dragonfishes ascribed to the family Melanostomiidae by Beebe and Crane (1939) and Morrow and Gibbs (1964), neither work mentions these dark patches. Whether it occurs only on *P. achirus* is unknown at this time.

Distribution: Known from western Atlantic and Caribbean, north Pacific near Hawaii and Tasman Sea at depths of 75–1400 m (Clarke, 1974; Froese and Paul, 2011; Morrow and Gibbs, 1964; Sutton and Hopkins, 1996) and now recorded from the equatorial western Pacific Ocean in the vicinity of Howland and Baker islands.

Comparative material examined

Photonectes albipennis (AMS I.221809-030, SIO 73-149).

Photonectes braueri (AMS I.20305013).

Photonectes caeruleus (SIO 76-6, USNM 256901).

Photonectes cf. gracilis (AMS I.20941-010, USNM 300157).

Photonectes margarita (SIO 69-354).

Photonectes mirabilis (AMS I.19739-018) [re-identified as *P. achirus*].

Photonectes parvimanus (SIO 10-177).

Acknowledgements

Curatorial assistance was provided by H. J. Walker, Jr. (SIO), M. McGrouther (AMS), and S. Jewett (USNM). The first author's research was supported by The University of Queensland Research Scholarship and a Graduate School Research Travel Grant from The University of Queensland. We thank Ted Waitt and the Waitt Institute for the invitation to take part in a voyage to the equatorial western Pacific Ocean aboard *R/V Seward Johnson* (Catalyst II expedition) and this

expedition was supported by The University of Queensland Deep Ocean Australia Project (ARC-linkage grant # LP0775179 to Prof. Justin Marshall). Alan Goldizen and David Wheeldon (The University of Queensland) made collections of *P. waititi* and *P. achirus* on the second leg of the Catalyst II expedition. We thank M. Gomon and D. Bray (NMV) for their support throughout this project and for use of NMV facilities. M. Gomon provided valuable comments on a draft of this manuscript. We are grateful to J. Paxton (AMS) for bringing the authors together and encouraging our research; R. Rosenblatt, P. Hastings and H. J. Walker, Jr. (SIO) for support and encouragement, and for use of laboratory facilities.

References

- Beebe, W. and Crane, J. 1939. Deep-sea fishes of the Bermuda Oceanographic Expeditions. Family Melanostomiidae. Zoologica, N.Y., 24(6): 65-238.
- Clarke, T.A. 1974. Some aspects of the ecology of stomiatoid fishes in the Pacific Ocean near Hawaii. Fisheries Bulletin 72(2): 337-351.
- Eschmeyer, W.N. (ed.). 2011. Catalog of Fishes. World Wide Web electronic publication <http://research.calacademy.org/ichthyology/catalog/fishcatmain.asp> accessed on 29 March 2011.
- Froese, R. and Paul, D. (eds.). 2011. FishBase. World Wide Web electronic publication (version 02/2011) <http://www.fishbase.org/search.php> accessed on 29 March 2011.
- Harold, A.S. 2003. Melanostomiidae: scaleless dragonfishes, Pp. 907-912. In: Carpenter, K.E. and Walker, R.W. (eds.), *FAO Species Identification Guide for Fishery Purposes. The living marine resources of the western central Atlantic*. Vol. 2: Bony fishes part 1 (Acipenseridae to Grammatidae). FAO, Rome.
- Klepado, C. 2011. Three new species of the genus *Photonectes* (Teleostei: Stomiiformes: Stomiidae: Melanostomiinae) from the Pacific Ocean. Copeia 2011(2): 201-210.
- Morrow, J.E., and Gibbs, R.H.Jr. 1964. Family Melanostomiidae, Pp. 351-510 In: Bigelow, H.B., Breder, C.M., Cohen, D.M., Mead, G.W., Merriman, D., Olsen, Y.H., Schroeder, W.C., Schultz, L.P. and Tee-Van, J. (eds.), *Fishes of the Western North Atlantic*. Vol. 1. Part 4. Yale University, New Haven.
- Nelson, J.S. 2006. *Fishes of the World*. John Wiley and Sons, New York.
- Regan, C.T., and Trewavas, E. 1930. The fishes of the families Stomiidae and Malacosteidae. *Danish Dana Expedition 1920-22* 6: 1-143.
- Sutton, T.T., and Hopkins, T.L. 1996. Species composition, abundance, and vertical distribution of the stomiid (Pisces: Stomiiformes) fish assemblage of the Gulf of Mexico. Bulletin of Marine Science 59: 530-542.
- Weitzman, S.H. 1974. Osteology and evolutionary relationships of the Sternoptychiae, with a new classification of stomiatoid families. Bulletin of the American Museum of Natural History 153: 327-478.
- Williamson, M., and McGowan, J.A. 2009. The copepod communities of the north and south Pacific central gyres and the form of species-abundance distributions. Journal of Plankton Research 32: 273-183.